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(71) Applicant: **VALMET-AHLSTROM INC.**
SF-48601 Karhula(FI)

(72) Inventor: **Kohosalmi, Jukka**
Kumputie 14
Kouvola(FI)

(74) Representative: **Gilmour, David Cedric Franklyn et al**
POTTS, KERR & CO. 15 Hamilton Square
Birkenhead Merseyside L41 6BR(GB)

(54) Press section of a paper, cardboard, or pulp drying machine.

(57) A press section of a paper, cardboard, or pulp drying machine with several separate press nips (N_1, N_2, N_3) in the direction of the passage of the web (W), wherein the said press nips remove considerable quantities of water from the web (W). Each nip is formed between two press rolls (21,31; 41,51; 61,71), and in the first two nips (N_1 N_2) the web (W) runs between two water-receiving press felts (20,30; 40,50; 60,70). Dewatering takes place in the said nips (N_1, N_2) through both surfaces of the web (W), wherein the said nips (N_1, N_2) are formed between two open-faced rolls. Transfer felt or felts (1; 101, 201, 301) are arranged in the press section, wherein the said transfer felt or felts are permeable to water and do not absorb considerable quantities of water into themselves, and wherein the said transfer felt or felts are arranged to run through the said press nips (N_1, N_2, N_3) formed by open-faced rolls, between the second press felt (30, 50, 70) of the nip and the web (W), in order to considerably support the web (W) on the runs between the nips (N_1, N_2, N_3) to achieve closed draw of the web.

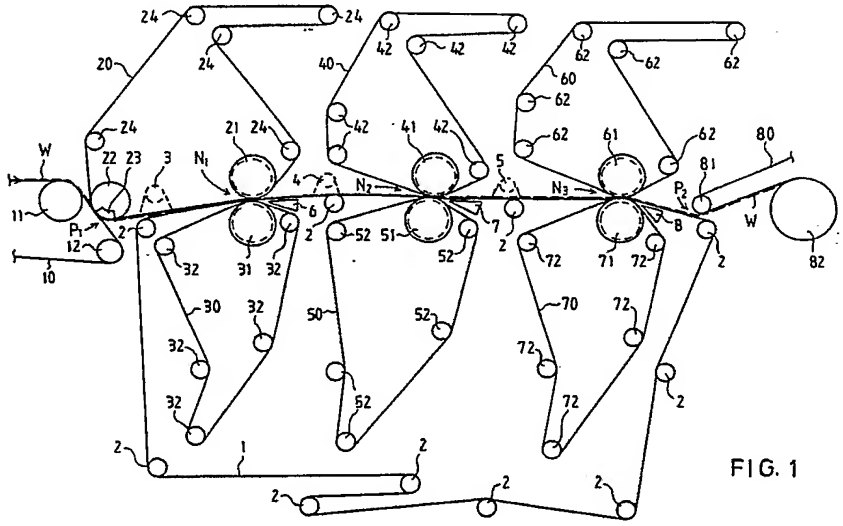

FIG. 1

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The present invention relates to a press section of a paper, cardboard, or pulp drying machine. In the press section, in the direction of web passage, there are several separate press nips, which remove water from the web to a substantial extent. Each press nip is formed between two press rolls, and in the two first of these nips the web runs through two water-receiving press felts so that dewatering takes place in the said nips through both surfaces of the web, and at least the two first said nips are formed between two open-faced rolls.

Dewatering of a paper, cardboard, or pulp web by evaporation consumes large amounts of energy and is therefore costly and uneconomical. For this reason, it is usually attempted to remove as much water as possible from the web by mechanical means before the web reaches the dryer section. The most important stage in this process is the press section, where water is removed from the web by pressing the web between rolls. It is well known that water will be more readily removed from the web when the temperature is raised, because the viscosity of water and the web coefficient of elasticity under tension are thereby reduced, as is the surface tension. In this manner, the dry substance content or the web after the press section is considerably increased resulting in significant savings in the consumption of energy for drying.

As the rate of production or a paper and cardboard machine is increased, one additional bottleneck are free draws of the web in the press section, and on the other hand the free draws of the web after the press section for example from the press section to the dryer section. In addition, in such conventional presses, where the web is drawn through press nips so that at least on one side of the web there is a press felt into which water is absorbed from the web, one drawback is rewetting of the web after the nip, because after the nip the web tends to reabsorb water into itself. Earlier there have been attempts to prevent rewetting by for example keeping the web tighter. This has resulted in the drawback that the risk of web breaks has considerably increased. As discussed above, it is economical from the point of view of energy consumption if as much water as possible can be removed from the web already in the press section before the web reaches the dryer section. For example in paper machines the rule of thumb is that if the wetness of the web can be reduced in the press section by 1 %, the consumption of steam in the dryer section is reduced by 5 %. As also discussed above, it is considered that one means of increasing the dry substance content in the press section is raising the temperature of the web. However, because in the prior art press sections there have been several free draws of the web, in which draws the web has been running without any kind of support, heating of the web for example by means of steam boxes has been very difficult to carry out. In this manner, raising the temperature has been one problem in press sections of prior art.

In the conventional press sections it has been necessary to use an expensive press-suction roll. However, the use of press-suction roll involves considerable draw-backs, which will be shortly discussed below.

The perforation of a press-suction roll may leave a marking in the web, and this impairs the appearance of the paper, and may affect the surface properties of the paper. The drilling of the press-suction rolls is a difficult and costly procedure. The perforation reduces the strength of the shell of the roll, and because of this it is necessary to use special metal alloys as material for the rolls, together with the requirement of great thickness of the shell, which result in high material costs. In addition, press-suction rolls consume large quantities or air.

Additional prior art reference is made by way of examples to U.S. Pat. Nos. 3,268,390 and 4,219,383, in which are presented such open press sections, where there are several separate nips formed by pairs of press rolls. The press sections presented in the U.S. patents mentioned above have certain drawbacks, for example that the web tends to become wet again after the press nips. This rewetting has been particularly detrimental between the second and third nips, and especially when thin paper qualities are manufactured. As a rule, after the second nip in the said prior art press sections, the dry substance content of the web has been relatively high, and when the web is transferred into the third nip carried by the press felt, water is reabsorbed into the web. In the said prior art press sections, attempts have been made to detach the web from the press felt immediately after the third nip, which has partly resulted in the necessity to carry the web as an open draw into the dryer section. Open draws cause the risk of web breaks, because the strength of the web immediately after the press section is still relatively low due to its water content.

Futhermore, with respect to the press section presented in U.S. Pat. No. 3,268,390, the transfer of the web after the second nip onto the second upper press felt is secured by means of a suction-pick-up roll, and the said rewetting of the web occurs during the run of the web after the suction-pick-up roll. Furthermore, as disclosed in the U.S. Pat. mentioned above, after the third press nip the web has an open draw into the dryer section. As disclosed in the U.S. Pat. No. 4,219,383, the web runs through all three successive press nips carried

by the same lower felt functioning as the press felt. In this case rewetting of the web occurs between the nips when water is reabsorbed after the nips from the lower felt back into the web.

In the Finnish patent application No. 833132 is presented a press section of a paper machine, where the press section consists of separate presses. As disclosed in the said FI patent application, the press section is meant for dewatering that takes place on one surface, because, as disclosed in the FI patent application, the water absorbing press felt is arranged only on one side of the web. In addition, at least in one press nip of the press section is used an expensive press-suction roll. As disclosed in the said patent application, the goal has been to achieve a closed draw of the web between the press nips so that on opposite side of the web in relation to the felts there is arranged a transfer felt, which supports the web and transfers it from one nip to another. However, in the FI patent application No. 833132, the transfer felt is smooth-faced and is not permeable to water. A solution that resembles the above mentioned FI patent application is presented in the Finnish patent application No. 823187, where the press section includes press felts on one side of the web, and on the opposite side of the web water-non-receiving transfer felt to achieve a closed draw of the web. Thus the solution in this patent application does not achieve dewatering from both surfaces, either.

The object of the present invention is to provide a press section that removes, or at least substantially reduces drawbacks of prior art press sections. In order to attain this goal, the principal feature of the invention is that into the press section, through the said press nips formed by open-faced rolls, between the second press felt of the nip and the web, a transfer felt or felts are arranged to considerably support the web in the runs between the nips in order to achieve a closed draw of the web. The said transfer felts are permeable to water and do not absorb considerable quantities of water into themselves.

Compared to prior art, the invention has several advantages of which for example the following can be mentioned. The most important advantage compared to prior art is that in the press section of the invention the draw of the web takes place as a closed draw so that the web is in the press section supported by the transfer felt. Because of this the press section can be run at a higher speed than previously known press sections. Another considerable advantage is that in accordance with the invention dewatering is achieved on both surfaces in all press nips and that rewetting of the web can be prevented almost completely, because the web can be detached from the press felts by means of the transfer felts immediately after the nip. Another advantage compared to prior art is that in the press section, according to the invention, there is no need to use an expensive suction roll as press roll, but an ordinary open-faced roll is used as press roll. Since in the press section of the invention the transfer felt supports the web between nips, an additional advantage of the invention is that a steam blow onto the web can easily be situated before each nip in order to raise temperature of the web and in this manner improve the dry substance content. Other advantages and characteristics of the invention are given below in the detailed description of the invention.

Next, a detailed specification of the invention is given by reference to the figures of the accompanying drawing.

FIG. 1 is a schematic side elevation of a first embodiment of the press section of the invention.

FIG. 2 is an elevation corresponding to FIG. 1, and it illustrates a second embodiment of the press section of the invention.

FIG. 3 is an elevation corresponding to FIGS. 1 and 2, and it illustrates a third embodiment of the press section of the invention.

FIG. 4 is a more detailed elevation of the first press nip of the press section.

In accordance with FIGS. 1, 2, and 3, the web W is formed on wire 10, which is either a Fourdrinier wire or a supporting wire of a two-wire forming section. During the downward run of the the wire 10, between the suction couch roll 11 and the wire driving roll 12, the web W is transferred in the detaching point P_1 in the suction zone 23 of the pick-up roll 22 onto the first top felt 20, which thus functions also as a pick-up felt. The first top felt 20 carries the web W on its bottom side into the first nip press N_1, which is formed between two press rolls, namely between the first top roll 21 and first bottom roll 31. The first top felt 20 forms an endless loop by means of felt rolls and guide rolls 24, which also keep the said felt 20 appropriately tight. The first nip N_1 is provided with two press felts, namely with the said first top felt 20 and with the first bottom felt 30, which also forms an endless loop by means of felt rolls and guide rolls 32. These rolls also keep the first bottom felt 30 appropriately tight. The press rolls 21 and 31 of the first press nip N_1 are open-faced press rolls, as illustrated in FIGS. 1 - 3 with a broken line. In FIG. 4 the said open faces are denoted by reference numerals 21a and 31a.

In accordane with FIGS. 1. 2 and 3, the first press nip N_1 is followed in the direction of the web W by a second separate press nip N_2, which is formed between two press rolls, namely between the second top roll 41 and the second bottom roll 51. The second press nip N_2 is also provided with

two press felts, namely with the second top felt 40 and the second bottom felt 50. In the same manner as in the first press nip N_1, the second top felt 40 forms an endless loop by means of felt rolls and guide rolls 42 which also take care of tightening the second top felt 40. In the same manner, the second bottom felt 50 is formed into an endless loop by means of felt rolls and guide rolls 52, which keep the second bottom felt 50 appropriately tight. The press rolls 41 and 51 of the second press nip N_2 are also open-faced press rolls.

The second press nip N_2 is followed in the direction of the web W by a third separate press nip N_3. The third press nip N_3, mentioned in the embodiments of FIGS. 1 and 2, is formed between two press rolls, namely between the third top roll 61 and the third bottom roll 71. The press rolls 61 and 71 are open-faced. As shown in FIGS. 1 and 2, the third press nip N_3 is provided, in the same manner as press nips N^1 and N_2 described above, with two press felts, namely with the third top felt 60 and the third bottom felt 70. The press felts 60 and 70 of the third press nip N_3 mentioned in the embodiments of FIGS. 1 and 2 are also formed into endless loops by means of felt rolls and guide rolls 62 and 72, which also take care of tightening the said felts 60 and 70. In the embodiments of FIGS. 1 and 2, it is thus achieved dewatering that takes place on both surfaces of the web W in all press nips N_1, N_2, N_3.

The embodiment of FIG. 3 differs from FIGS. 1 and 2 in the respect that in the embodiment of FIG. 3 the third press nip N_3 is provided with only one press felt, namely with the third bottom felt 70, which is formed into an endless loop in the same manner as in FIGS. 1 and 2 by means of felt rolls and guide rolls 72. In the embodiment of FIG. 3, the third bottom roll 71 can also be a similar open-faced press roll as described in the previous embodiments. Instead, the third top roll 61a in the embodiment of FIG. 3 is a smooth-faced press roll.

In the embodiment of FIG. 1, in the press section there is a transfer felt 1, which is formed into an endless loop by means of felt, guide, and stretcher rolls 2. The said transfer felt 1 runs through all press nips N_1, N_2 and N3 of the press section. The transfer felt is made of material that is permeable to water, but that does absorb considerable quantities of water into itself. The transfer felt 1 can be for example of single-layer thin wire felt, although some other materials and implementations can be used. In the embodiment of FIG. 1, the web W is thus supported by the transfer felt 1 all the way when the web runs through the press section. In the embodiment of FIG. 1, the said transfer felt is 1 arranged to run between the bottom felts 30, 50, 70 and the web W, but naturally the transfer felt 1 can be arranged to run between the top felts 20, 40, 60 and the web W.

Since the web W is in the press section supported by the transfer felt 1, it is easy to place steam boxes above the web W in order to heat the web W and to improve dewatering. In FIG. 1, the steam boxes are denoted by reference numerals 3, 4 and 5. Of the said steam boxes, the first steam box 3 is situated inside the first top felt loop 20, the second steam box 4 is situated on the run between the first press nip N_1 and the second press nip N_2, and the third steam box 5 is situated on the run between the second press nip N_2 and the third press nip N_3. As FIG. 4 illustrates, there is vacuum after the nips in the gap G between the felt 30 and the transfer felt 1 due to air vortex. This vacuum improves dewatering from the web W through the transfer felt 1 and reduces reabsorption of water into the web W. The said effect can be further intensified by situating for example a blow suction box in the gap G after the nip. FIG. 1 illustrates schematically that after each nip N_1, N_2 and N_3 a said blow suction box has been situated in the gap G between the transfer felt 1 and the corresponding felts 30, 50 and 70. In FIG. 1 the said blow suction boxes are denoted by reference numerals 6, 7 and 8.

After the web W has run through the whole press section in the embodiment of FIG. 1, the web W is shifted in the detaching point P_2 onto the drying wire 80 by means of transfer roll 81, and the drying wire 80 shifts the web W onto the drying cylinders, of which drying cylinders the first is denoted by reference numeral 82.

The embodiment of FIG. 2 differs from the embodiment of FIG. 1 in that in the embodiment of FIG. 2 there is an own transfer felt for each press. Thus in this embodiment there is a first transfer felt 101 running through the first press nip N_1. The said first transfer felt 101 is formed into an endless loop by means of felt, guide and stretcher rolls 102. In the same manner as in FIG. 1, also in this embodiment there is steam box 3 situated inside the top felt loop 20 to heat the web W, and there is blow suction box 6 situated in the gap G after the first nip N_1 between the first bottom felt 30 and the first transfer felt 101 in the same manner as in FIG. 1.

In the same manner, in the second press there is a second transfer felt 201 between the web W and the second bottom felt 50. The said second transfer felt 201 is formed into an endless loop by means of felt, guide and stretcher rolls 202. There is also a blow suction box 7 situated in the gap after the second nip N_2 between the second transfer felt 201 and the second bottom felt 50. In the same manner, in the third press there is a third transfer felt 301, which is formed into an endless loop by means of felt, guide and stretcher rolls

302. There is also blow suction box 8 situated in the gap after the third nip N_3 between the third transfer felt 301 and bottom felt 70. In addition, in the third press there is steam box 9 situated below the transfer felt 301. The steam box 9 blows steam through the said transfer felt 301 to the web W in order to heat the web.

In the same manner as in the embodiment of FIG. 1, also in the embodiment of FIG. 2 the web W is shifted in the detaching point P_2 onto the drying wire 80 by means of transfer roll 81. and the drying wire 80 shifts the web W onto the first drying cylinder 82 of the dryer section.

In the embodiment of FIG. 2 the closed draw of the web is achieved so that the web W is fetched from the transfer felt of the previous press by means of the top felt of the next press. Thus in FIG. 2 the first transfer felt 101 reaches to the region of the second top felt 40, and correspondingly the second transfer felt 201 reaches to the region of the third top felt 60. The advantage of the embodiment of FIG. 2 in comparison with FIG. 1 is that by using separate transfer felts 101, 201 and 301 it is possible to avoid the problems, which may be caused by speed differences between presses. The embodiment of FIG. 2 can also be carried out so that the transfer felts 101, 201 and 301 are situated in a way different from FIG. 2, namely between the web W and the top felts 20, 40 and 60. Other qualities and material of the transfer felts 101, 201 and 301 can be the same as of the transfer felt 1 described in FIG. 1.

As far as the two first presses of the press section are concerned, the embodiment of FIG. 3 is exactly similar to the embodiment of FIG. 2. For this part reference is thus made to the above description. Instead, in the embodiment of FIG. 3, in the third press it is not used a similar transfer felt as in the first and second presses. As described above, in this embodiment the third nip N_3 is formed between an open-faced bottom roll 71 and a smooth-faced press roll 61a. The press felt 70 is taken over the open-faced bottom roll 71 alone, and the said bottom felt 70 is formed into an endless loop by means of felt rolls and guide rolls 72. In the embodiment of FIG. 3, the draw of the web is thus not closed in the whole press section, but instead there is an open draw in point P_3 between the second and third presses as the web W is shifted from the second transfer felt 201 onto the third bottom felt 70. From the third press top roll 61a the web is shifted onto the drying wire 80 by means of transfer rolls 85 and 81, and the drying wire 80 shifts the web W onto the first drying cylinder 82 of the dryer section.

In the above description there have been mentioned some requirements for the qualities of the transfer felts 1, 101, 201 and 301. Among these requirements are in particular that the transfer felts are permeable to water and that the transfer felts must not absorb considerable quantities of water into themselves. Particularly in press sections of paper and cardboard machines an important quality of the transfer felt is that it must not leave marking in the web W.

The invention has been described above in an illustrative sense by making references to the numbers of the figures. It is therefore to be understood that the invention is not limited to the description presented in the figures, but instead changes are possible within the framework of the invention presented in the enclosed patent claims.

Claims

1. In a press section of a paper, cardboard, or pulp drying machine, in the direction of the passage of the web (W) there are several separate press nips (N_1, N_2, N_3) that remove considerable quantities of water from the web (W), each one of the said nips formed between two press rolls (21,31; 41,51; 61,71; 61a,71), and in the two first nips (N_1, N_2) of the said nips the web (W) runs between two water-receiving press felts (20,30; 40,50; 60,70) so that dewatering takes place through both surfaces of the web (W) in the said nips (N_1 N_2), and wherein the said at least two first nips (N_1, N_2) are formed between two open-faced (21a, 31a) rolls, **comprising** transfer felt or felts (1; 101, 201, 301) arranged in the press section, wherein the said transfer felt or felts are permeable to water and do not absorb considerable quantities of water into themselves, and wherein the said transfer felt or felts are arranged to run through the press nips (N_1, N_2, N_3) formed by the said open-faced rolls (21a, 31a), between the second press felt (30, 50, 70) of the nip and the web (W), in order to considerably support the web (W) on the runs between the nips (N_1, N_2, N_3) to achieve closed draw of the web.

2. A press section as claimed in in claim 1, **comprising** transfer felt (1) formed into an endless loop, which is arranged to run through the press nips (N_1, N_2, N_3) formed by press section open-faced rolls (21,31; 41,51; 61,71) as continuous run so that the web (W) is considerably supported by the said transfer felt (1) in the region of the whole press section.

3. A press section as claimed in claim 1, **comprising** at least two consecutive transfer felts (101, 201, 301) arranged in the press section so that there is an own transfer felt (101, 201, 301) arranged to run through at least one press nip (N_1, N_2, N_3) formed by the open-faced rolls (21,31; 41,51; 61,71).

4. A press section as claimed in claim 1, **comprising** an own transfer felt (101, 201, 301) arranged to run through each press nip (N_1, N_2, N_3) formed by the press section open-faced rolls (21,31; 41,51; 61,71).

5. A press section as claimed in claim 3 or 4, **comprising** separate transfer felts (101, 201, 301) arranged consecutively so that the transfer felt (101 or 201) running through the previous press nip (N_1 or N_2) reaches to the region of the press felt (40 or 60) of the next press nip (N_2 or N_3), wherein the press felt is on the opposite side of the web (W), in order to achieve closed draw from the transfer felt of the previous nip to the press felt of the next nip.

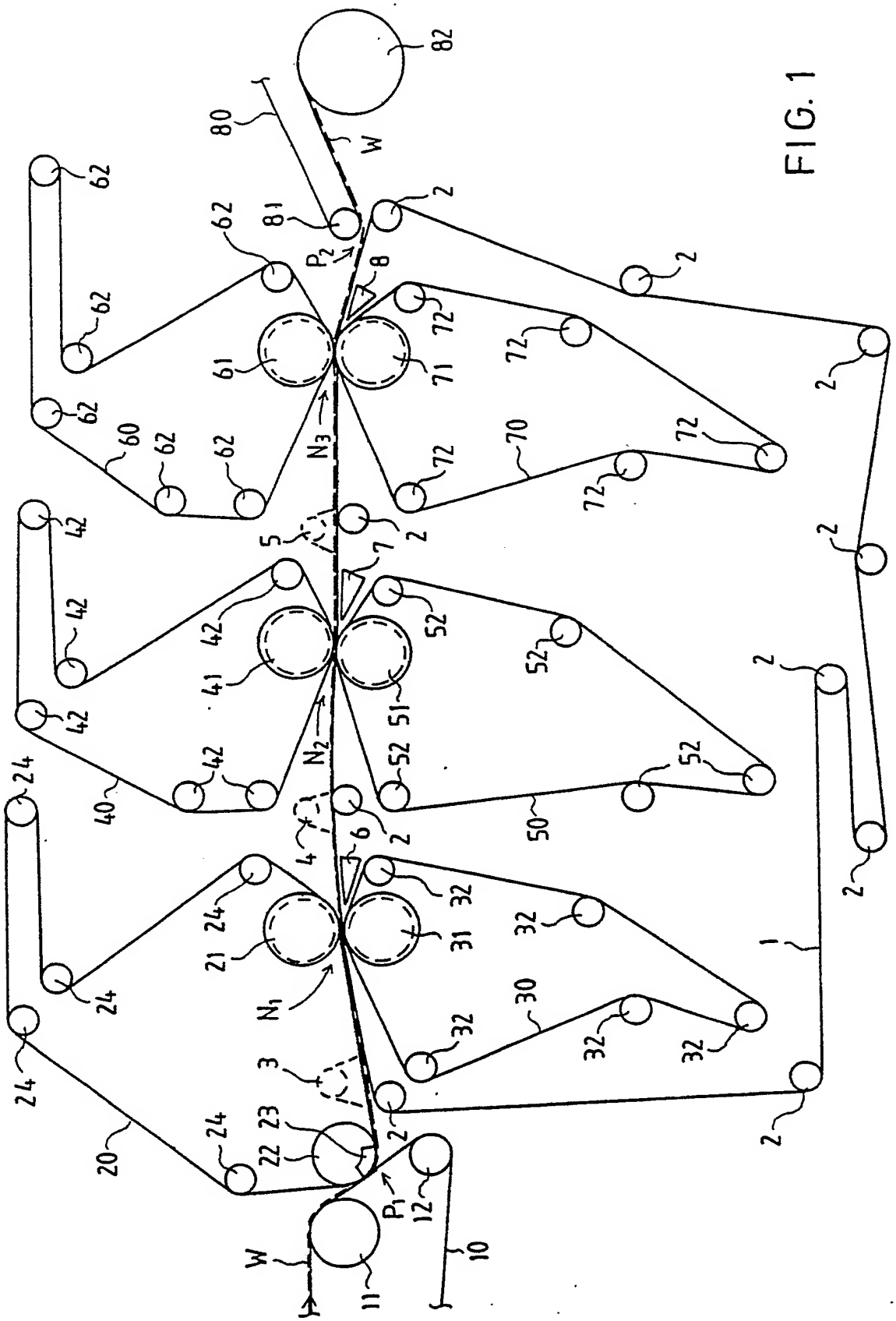
6. A press section as claimed in any of the above claims, **comprising** blow suction boxes (6, 7, 8) situated in the gap (G) after the press nips (N_1, N_2, N_3) formed by the open-faced rolls (21,31; 41,51; 61,71), between the transfer felt (1; 101, 201, 301) and the press felt (30, 50, 70) which is against the nip (N_1, N_2, N3) in order to improve dewatering through the transfer felt (1; 101, 201, 301).

7. A press section as claimed in any of the above claims, **comprising** at least one heating device (3, 4, 5, 9) situated in the region of press section transfer felt or felts (1; 101, 201, 301) in order to raise the temperature of the web (W) and to improve the dry substance content of the web (W).

8. A press section as claimed in claim 7, **comprising** heating device or devices (3, 4, 5, 9) that are situated in the press section before the nip/nips (N_1, N_2, N_3) formed by the open-faced rolls (21,31; 41,51; 61,71).

9. A press section as claimed in claim 7 or 8, **comprising** the said heating devices that include steam boxes (3, 4, 5, 9) or equivalent which are made to blow steam to the web (W).

10. A press section as claimed in claim 9. **comprising** steam boxes (3, 4, 5, 9) which are situated on the opposite side of the web (W) in relation to the transfer felt/felts (1; 101, 201, 301).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N_2
40
50
4
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N_1
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22
20
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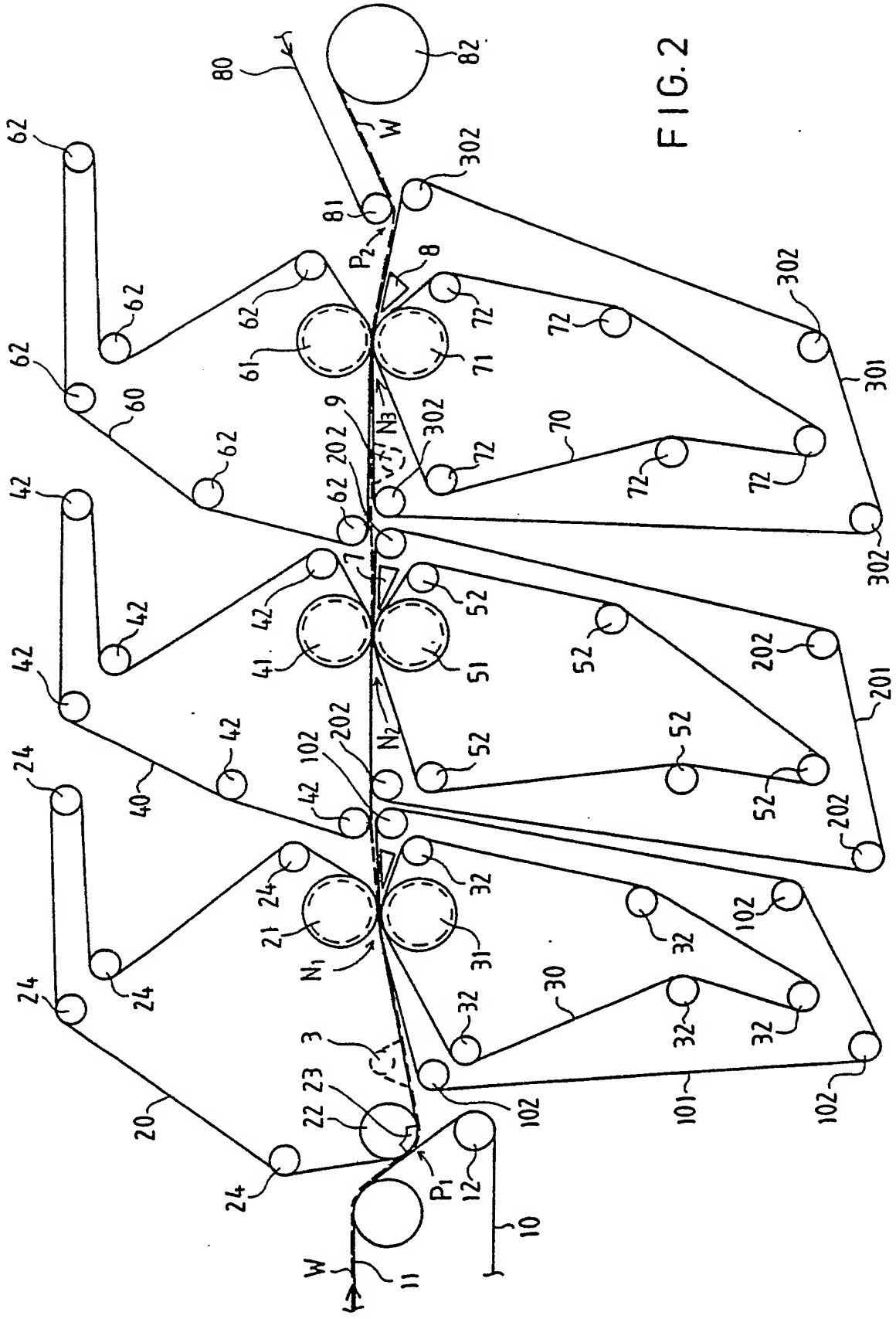
P_1
10
11

FIG. 1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N1
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31
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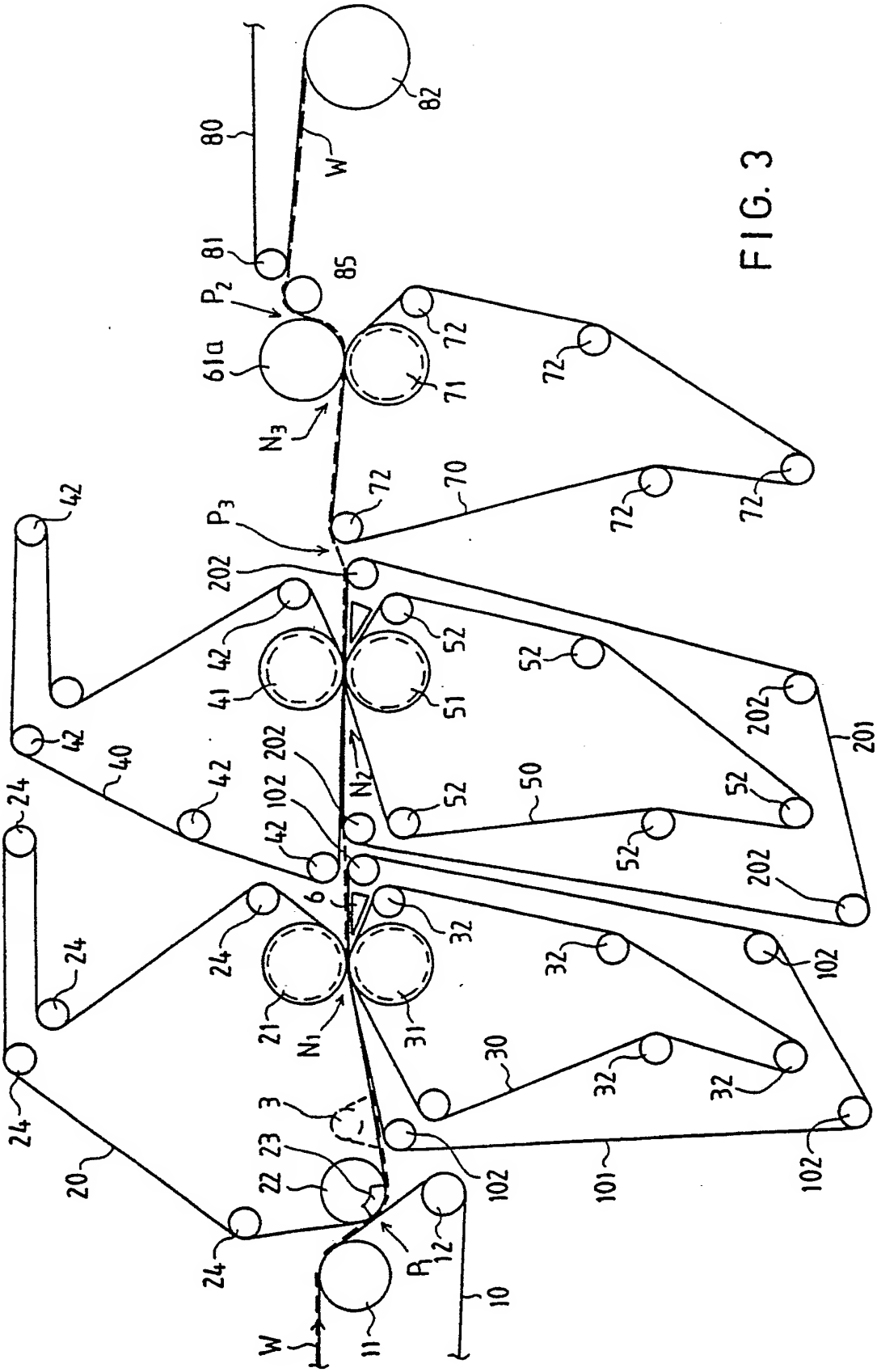
301
302

FIG. 2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P_3
202
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N_2
50
6
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3
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11
W

FIG. 3

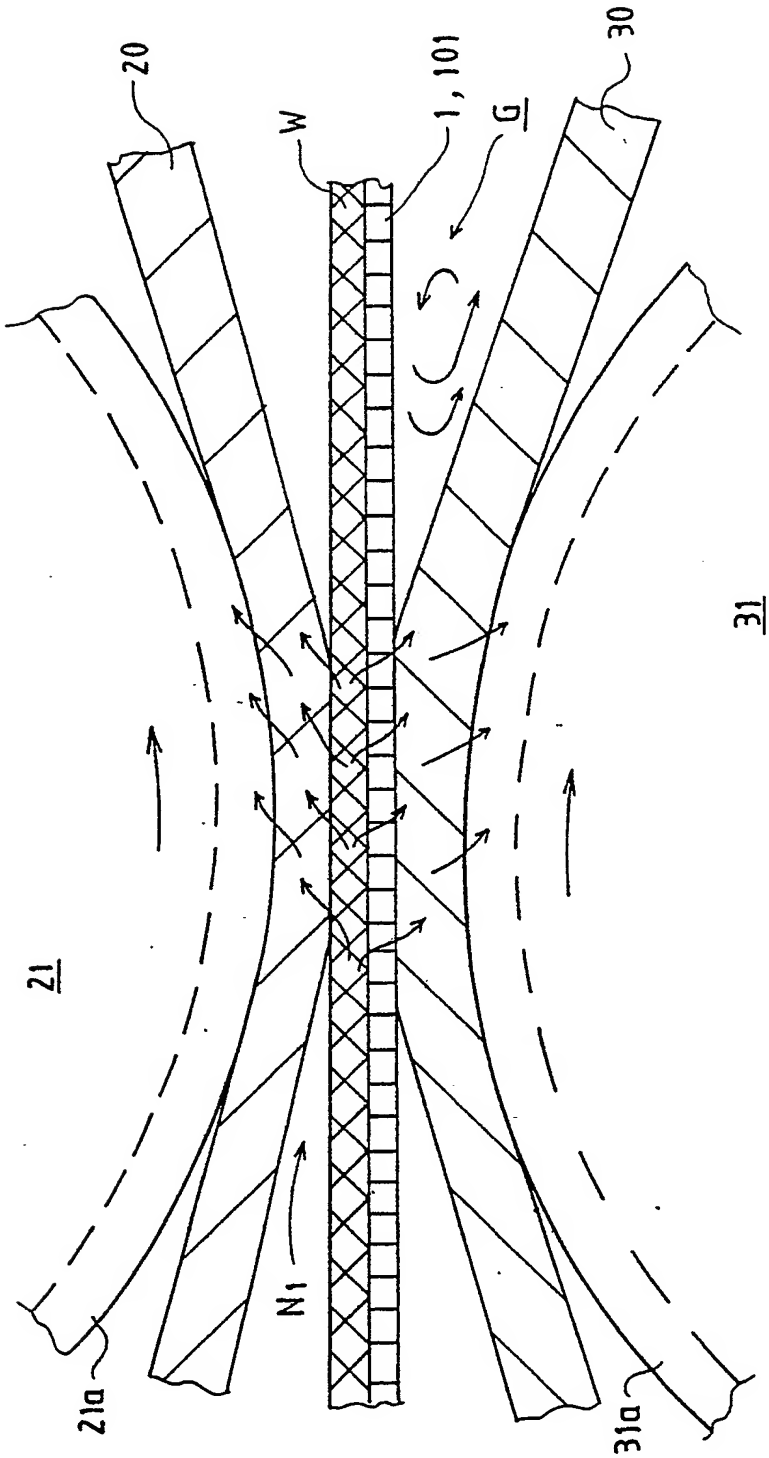

FIG. 4

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TITLE: Press section of a paper, cardboard, or pulp drying machine.

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INVENTOR-INFORMATION:

NAME	COUNTRY
KOHOSALMI, JUKKA	FI

ASSIGNEE-INFORMATION:

NAME	COUNTRY
AHLSTROEM VALMET	FI

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US-CL-CURRENT: 162/358.1 , 162/358.2

ABSTRACT:

A press section of a paper, cardboard, or pulp drying machine with several separate press nips (N1, N2, N3) in the direction of the passage of the web (W), wherein the said press nips remove considerable quantities of water from the web (W). Each nip is formed between two press rolls (21,31; 41,51; 61,71), and in the first two nips (N1 N2) the web (W) runs between two water-receiving press felts (20,30; 40,50; 60,70). Dewatering takes place in the said nips (N1, N2) through both surfaces of the web (W), wherein the said nips (N1, N2) are formed between two open-faced rolls. Transfer felt or felts (1; 101, 201, 301) are arranged in the press section, wherein the said transfer felt or felts are permeable to water and do not absorb considerable quantities of water into themselves, and wherein the said transfer felt or felts are arranged to run through the said press nips (N1, N2, N3) formed by open-faced rolls, between the second press felt (30, 50, 70) of the nip and the web (W), in order to considerably support the web (W) on the runs between the nips (N1, N2, N3) to achieve closed draw of the web.